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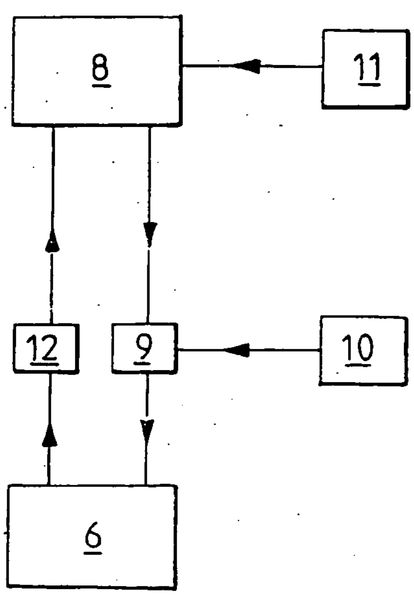
(54) Title: HYDRAULIC VEHICLE RETARDER AND METHOD OF CONTROLLING SUCH RETARDER



(57) Abstract: Hydraulic retarder installation with a retarder which is controlled by an electronic control unit (8), which regulates, via an electrically operated proportional valve (9), the air pressure in a hydraulic fluid reservoir (6), said pressure determining the braking torque. In the control unit there are stores command values of the pressure at a number of levels and values of the electric current through the valve at these levels. The control unit is disposed, upon activation of the retarder, by utilizing the stored electric current values and feed back of the measured air pressure on the outlet side of the proportional valve, to control the valve towards a pressure, which corresponds in turn to the requested braking torque.

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Hydraulic vehicle retarder and method of controlling such retarder

The present invention relates to a hydraulic retarder installation for motor vehicles, comprising a stator solidly mounted in a housing, a rotor rotatably mounted in the housing, a reservoir for hydraulic fluid, an electrically operated proportional valve in a compressed air connection between a source of compressed air and the reservoir, an electronic control unit, which controls the proportional valve as a function of signals from a brake control, and an air pressure sensor, which sends a signal to the control unit dependent on the air pressure on the outlet side of the proportional valve.

The invention also relates to a method of controlling the braking torque form such a hydraulic retarder installation.

Retarder installations known up to now of this type have control units which, in response to a signal to activate the retarder to apply a certain braking torque, initially apply a current over the solenoid of the proportional valve, which is estimated to provide an air pressure corresponding to the requested braking torque. In order to obtain a rapid response, i.e. a rapid increase in pressure, the control unit initially directs an electric current of higher magnitude than what is required to maintain the desired braking torque. The air pressure feeds back the current value of the pressure obtained, and the control unit then corrects the electrical control current so that the current value of the pressure is adjusted towards a predetermined pressure, which corresponds to the requested braking torque.

Due to tolerances and variations in the characteristics of the valve springs of the proportional valves, the braking torque, which is initially obtained upon activation of the retarder will vary between different retarder installations. At one extreme the torque will be substantially higher than what is desired. Gradually the retardation is eased to the desired level by feeding back the pressure to the control unit. At the other extreme, the torque will be substantially lower than that desired, which will instead result in the initial retardation

being lower than what is desired. The retardation will then gradually increase to the desired level by feed-back of the pressure to the control unit.

The purpose of the present invention is to achieve a hydraulic retarder installation of the type described by way of introduction, through which variations in the reaction between the different proportional valves can be compensated so that the braking torque upon activation of the retarder can be controlled more rapidly towards the requested torque.

This is achieved according to the invention by virtue of the fact that in the control unit there are stored command values of the pressure on the outlet side of the proportional valve at a number of levels and values of the electric current through the proportional valve at said pressure levels and that the control unit is arranged, upon actuation of the brake control for activating the retarder, through utilization of the stored electric current values and feed-back of the measured air pressure on the outlet side of the proportional valve to control the proportional valve towards a pressure corresponding to the requested braking torque.

Before the retarder installation is put into operation in the vehicle, the control unit is activated according to the invention, under stationary conditions, both as regards the controlling of the proportional valve by the control unit and the signal from the air pressure sensor to the control unit to read and store various connected values of pressure and electric current strengths and upon activation of the retarder said connected values are utilized to control the proportional valve towards a pressure corresponding to the requested braking torque. In this way the same response is obtained in different retarder installations regardless of the spreading and the difference in reaction between the different proportional valves.

The invention will be described in more detail below with reference to examples shown in the accompanying drawings, where Fig. 1 shows a schematic perspective view of a known hydraulic retarder, Fig. 2 shows a schematic diagram of one embodiment of a re-

tarder installation according to the invention, Fig. 3 is a diagram of the response of the proportional valve in a known retarder installation upon activation of the retarder, Fig. 4 is a corresponding diagram of the reaction of the proportional valve in a retarder installation according to the invention and Fig. 5 is a calibration diagram.

The retarder 1 shown in Fig. 1 is a hydraulic retarder which is known per se and comprises a housing 2 with a stator 3 arranged solidly in the housing and a rotatably mounted rotor 4, which is connected, in a manner not shown in more detail here, to the output shaft of the vehicle gearbox and thus also to the vehicle propeller shaft 5. The retarder 1 has a tank 6 for hydraulic fluid and a cooler 7 for cooling the fluid.

As can be seen schematically in Fig. 2, the retarder 1 is controlled by an electronic control unit (control computer) 8, which can be the same unit as that controlling the various functions of the engine, the clutch and the transmission. The control unit 8 controls a regulator valve in the form of an electrically operated proportional valve 9, which is coupled between a compressed air source (accumulator tank) 10 and the hydraulic fluid tank 6 of the retarder 1. When compressed air is supplied to the tank 6, fluid is pressed in between the rotor 4 and the stator 3 of the retarder, thus gene-rating braking torque, the magnitude of which is dependent on the volume of the fluid which is pressed by the compressed air into the chamber in which the rotor rotates. The magnitude of the fluid volume is dependent on the pressure of the compressed air supplied to the tank 6, and this pressure is determined by the setting of the proportional valve 9. This setting is in turn determined by the strength of the electric current which the control unit 8 sends to the solenoid of proportional valve 9.

When the retarder 1 is to be activated, the driver actuates a brake control 11, which can be a separate retarder control or the ordinary brake pedal of the vehicle. The control 11 sends a signal to the control unit 8 representing the braking torque requested by the driver. The control unit 8 then sends out a predetermined current depending on the requested braking torque. Manufacturing tolerances, resulting in a certain variation as regards the setting of the proportional valve 9 and thus the pressure which determines the braking torque, cause

in this case variations in the initial braking torque between different retarder installations having identically program-med control units 8.

In order to obtain a rapid response, i.e. an even and rapid build up of torque towards the requested torque. the control unit 8 provides initially an electric current I is accordance with a regulator algorithm, designed in a known manner. One example is illustrated in Fig. 3. By feedback to the control unit by means of a pressure sensor 12 which senses the value of the pressure, the control unit 8 adjusts the electric current to the value I_f, which provides the value of the pressure corresponding to the command value corresponding to the requested braking torque. Since the final level I_f of the electric current is not initially known, normally there is always an oscillation sequence, which results in poorer braking torque during the oscillating approach sequence.

Fig. 4 shows corresponding electric current and pressure curves for a hydraulic retarder installation with a control unit 8 in which there are stored , according to the invention, the command values of the pressure p on the outlet side of the proportional valve 9 at a number of levels and the electric current I through the valve at these pressure levels. Under stationary conditions, the air pressure p and the corresponding current I are measured and stored in the control unit for later use in compouting I_f. A number of different air pressures p and corresponding electric surrents I can be measured and stored in the control unit 8 to increase the performance of the retarder installatino for differrent requested braking torques. This is illustrated in the diagram in Fig. 5. In order to obtain a more rapid and more even build up of torque towards the requested torque, the control unit 8 initially sends out an electric current I consisting of I_f calculated from the calibration data together with a supplement ΔI from a regulator algorithm. The supplement ΔI is initially required during the period from t_0 to t_2 to accelerate the buildup of torque, while I_f is used in the stationary condition after the time t_2, where ΔI can be zero, when that calibration data is entirely adapted to the retarderinstallation. Since the final level I_f of the electric current is known from the start, there is normally no oscillation approach.

Claims

1. Hydraulic retarder installation for motor vehicles, comprising a retarder (1) with a stator (3) solidly mounted in a housing (2), a rotor (4) rotatably mounted in the housing, a reservoir (6) for hydraulic fluid, and an electrically operated proportional valve (9) in a compressed air connection between a source of compressed air (10) and the reservoir, an electric control unit (8), which controls the proportional valve as a function of signals from a brake control (11), and an air pressure sensor (12), which sends a signal to the control unit dependent on the air pressure on the outlet side of the proportional valve, **characterized** in that in the control unit (8) there are stored command values (P_n) of the pressure on the outlet side of the proportional valve (9) at a number of levels and values (I_n) of the electric current through the proportional valve at said pressure levels and that the control unit is arranged, upon actuation of the brake control (11) for activating the retarder (1), through utilization of the stored electric current values and feed-back of the measured air pressure on the outlet side of the proportional valve (9) to control the proportional valve towards a pressure corresponding to the requested braking torque.

2. Method of controlling the braking torque from a hydraulic retarder (1), having a stator (3) solidly mounted in a housing (2), a rotor (4) rotatably mounted in the housing, a reservoir (6) for hydraulic fluid, and an electrically operated proportional valve (9) in a compressed air connection between a source of compressed air (10) and the reservoir, an electronic control unit (8), which controls the proportional valve as a function of signals representing braking moment requested by the driver, and an air pressure sensor (12), which sends a signal to the control unit dependent on the air pressure on the outlet side of the proportional valve, **characterized in that** the control unit (8) is activated under stationary conditions, both as regards the controlling of the proportional valve by the control unit and the signal from the air pressure sensor to the control unit, to read and store various connected values of pressure (p_n) and electric current strengths (I_n) and upon activation of the retarder said connected values are utilized to control the proportional valve (9) towards a pressure corresponding to the requested braking torque.

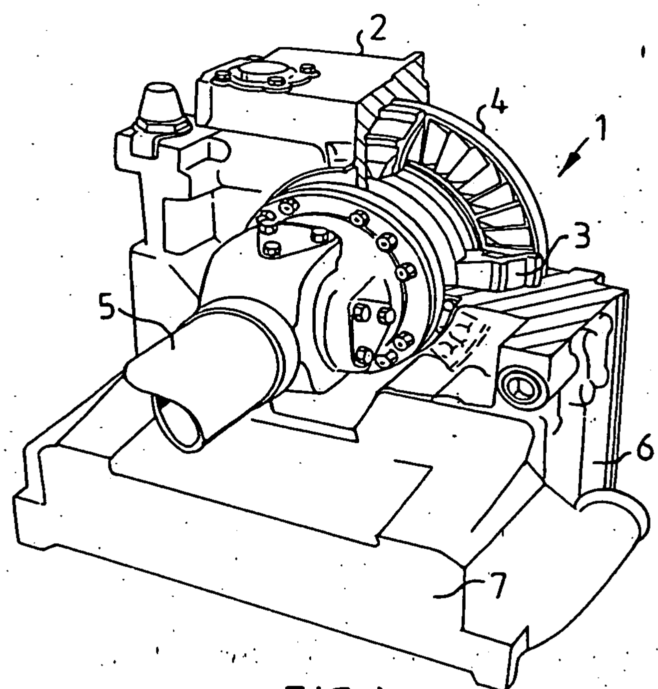

FIG.1

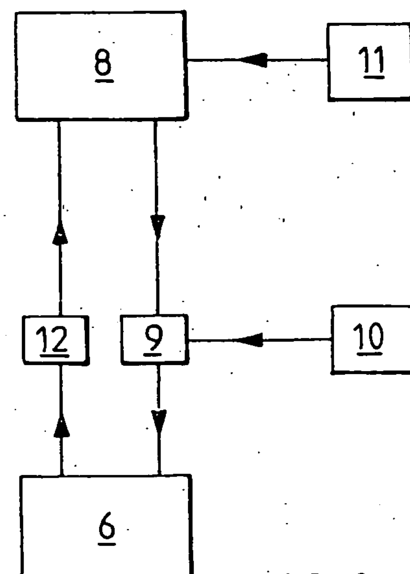

FIG. 2

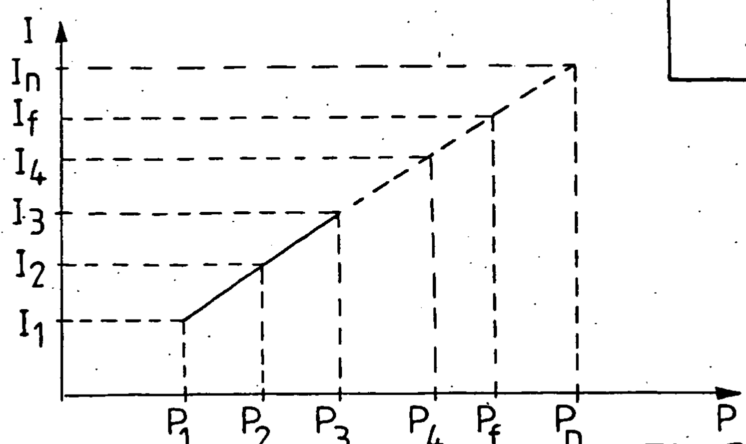

FIG.5

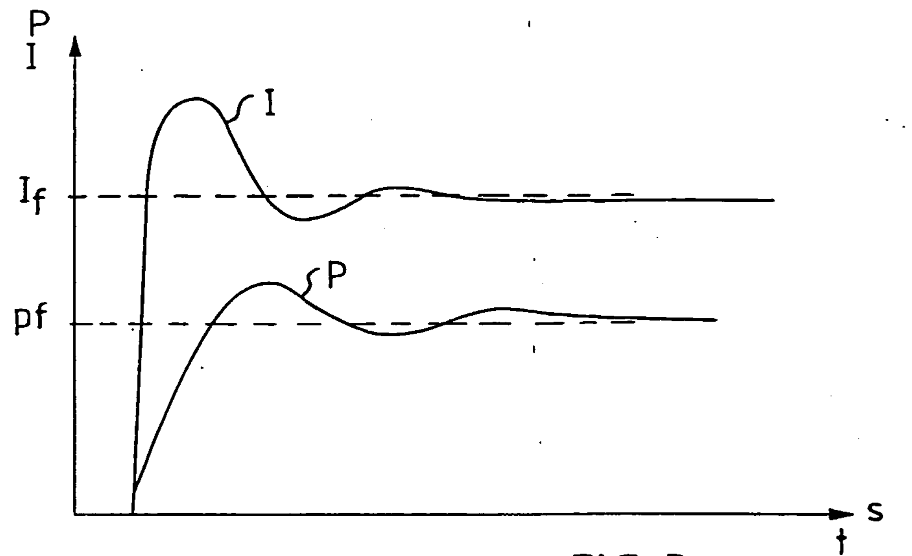

FIG. 3

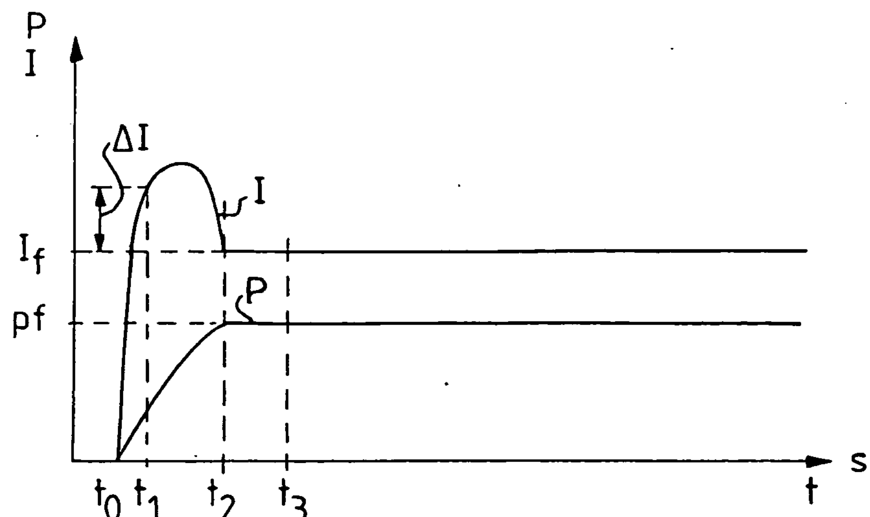

FIG.4